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Applicant DORLING, Michael, George, Land	

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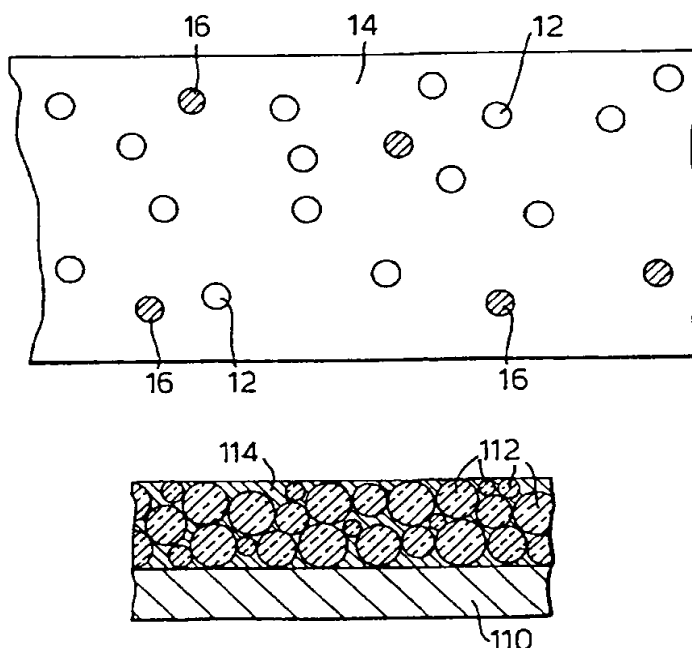
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(54) Title: HIGH CONTRAST SCREEN MATERIAL

(57) Abstract

A high contrast projection or depixelating screen comprises a primary matrix (14) of a first transparent material, bodies (12) of a second transparent material of a different refractive index from the first material and, additionally, light absorbing or filtering bodies (16). In variants, the matrix (114) is a light filtering material and incorporates discrete bodies (112) of light transmitting material.



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Title: "High Contrast Screen Material"

THIS INVENTION relates to a light diffusing optical screen material such as may be used, for example, as a rear or front projection screen or as a depixelating screen for reducing the perception of individual pixels in a pixelated (e.g. LCD) display or, analogously, of the individual scan lines of a CRT display.

The formulation and processing of polymer materials to create diffusers suitable as optical screen materials have been described in US-A-2287556 (Land), US-A-4983016 (Yamamoto), EP-A-0464499 (Sumitomo) and EP-A-0843203 (Nashua). These specifications describe symmetrically and asymmetrically diffusing optical screen materials which may be created by extrusion or casting. Asymmetry in diffusion is imparted typically by stretching to create orientation. However all the above materials appear "white" to a greater or lesser extent in ambient lighting conditions, that is without illumination from an imaging system. The whiteness is a function of light scattering by the dispersed particles incorporated in the materials to render them light-diffusing. As a result of this whiteness, an image created optically in the diffusing material suffers from a lack of contrast. Contrast may be recovered or improved for example, by the addition of a polarising film as described in the Sumitomo Japanese laid open Application No. 5-113606 or by the use of a second layer of a tinted acrylic material. Although both these approaches can improve contrast, this is achieved with a significant loss in brightness (gain), (as much as 50% where a polarising film is used).

It is an object of the present invention to provide a diffusing material providing improved contrast without a significant reduction in brightness.

According to one aspect of the invention there is provided a high contrast projection, depixelating, or the like screen, comprising a primary matrix of a first, transparent material, a first quantity of discrete bodies of a second transparent material of a refractive index different from the primary matrix material distributed in said primary matrix and a second quantity of discrete light absorbing or filtering bodies distributed in said primary matrix.

According to another aspect of the invention, there is provided a method of forming a screen according to the first-mentioned aspect, comprising compounding, in a molten or plastic state, a first light-transmitting thermoplastics matrix material with a second light-transmitting thermoplastics material insoluble in, and having a different refractive index from the first, and with a third thermoplastics material insoluble in the first, said third material being light-absorbing or attenuating, the method further comprising extruding the resulting compound through a slot.

Preferably, particularly where a high density of the discrete bodies in the primary matrix is contemplated, the second and third plastics materials are also mutually incompatible (i.e. mutually insoluble).

According to yet another aspect of the invention there is provided a high contrast projection, depixelating, or the like screen, comprising discrete bodies of a first material and refractive index in a matrix of a second material and refractive index, one said material being transparent and the other being light-filtering.

According to still another aspect of the invention there is provided a method of forming a screen, comprising forming a mixture comprising a plurality of discrete light-transmitting bodies in a fluid, light-filtering matrix or binder,

forming the resulting mixture into a thin layer or sheet, and causing or allowing at least said binder to set.

Embodiments of the invention are described below by reference to the accompanying drawings, in which:-

FIGURE 1 is a schematic view, in cross section perpendicular to the plane of the sheet material, through a first form of light diffusing sheet material embodying the invention,

FIGURE 2 is a schematic view, in cross section perpendicular to the plane of the sheet material, through another form of light diffusing sheet material embodying the invention,

FIGURE 3 is a view similar to Figure 2, illustrating a further embodiment, and

FIGURE 4 is a view similar to Figures 2 and 3, illustrating a still further embodiment.

Referring to Figure 1, a high-contrast light-diffusing material embodying the invention comprises a transparent primary matrix 14 incorporating a first quantity of discrete transparent bodies 12 embedded in the matrix 14 and of a different, for example higher refractive index than the matrix 14, (these bodies being represented in Figure 1 as unshaded circles), and a second quantity of discrete light filtering or attenuating bodies 16 (represented in Figure 1 by shaded circles), the bodies 12 and 16 being fully interspersed and distributed evenly but at random throughout the primary matrix 14. Each body 16 preferably comprises a transparent matrix, (preferably of a different, (e.g. higher) refractive index than the primary matrix) within which is distributed

discrete light absorbing particles, such as particles of carbon-black. Alternatively, each body 16 may comprise a transparent material incorporating a light filtering dye, such as a neutral (as regards colour - i.e. grey) dye. In preferred embodiments of the invention, the primary matrix material 14 and the bodies 12 and 16 are of plastics materials, preferably thermoplastics, the matrix 14 defining a plastics sheet or film of a thickness of, typically 0.12 mm, with the mean diameter of the bodies 12, 16, being, for example, of the order of 5 to 10 microns (m^{-6}). In the preferred embodiment, the ratio, by volume, of the first bodies 12 to the primary matrix 14 is 15:85 whilst the ratio, by volume, of the second bodies 16 to the primary matrix is of the order of 2:100. The percentage, by volume of pigment (carbon black) in the bodies 16 in the preferred embodiment is about 2.5%, so that the pigment makes up around 0.05% by volume of the screen as a whole.

It will be appreciated that the bodies 16 are, at 5 microns to 10 microns diameter, significantly larger than (and additionally much more regular in shape than (being generally spheroidal or ellipsoidal)), the particles of filler or pigment, (such as carbon black or silica) conventionally incorporated in plastics material. (The same also applies, of course, to the bodies 12). It is contemplated that the light-transmitting or absorbing, respectively, particles 12 or 16 need not be of thermoplastics, but may be of other materials such as thermosetting resin, or glass (clear or pigmented) for example.

It will be appreciated that the structure described with reference to Figure 1 may be achieved in several ways. For example, pre-formed solid bodies 12, 16 of the desired size may be mixed with a molten thermoplastics polymer which is subsequently extruded, or extruded and blown, to form the sheet screen material, or respective quantities of incompatible thermoplastics materials may be compounded in a plasticised or molten state to break up the (molten)

materials forming the minor proportions of the blend into discrete globules of the desired size, suspended in a continuous matrix formed by the molten major component, and the resulting material may be formed into a sheet or film by any of a variety of methods known *per se*.

In the preferred embodiments, in which the bodies 12 and 14 are formed from thermoplastics incompatible with the thermoplastics matrix material 14 and the compounded mixture, in a molten or plasticised state is formed into a thin film by a process in which a smaller diameter tube formed by extrusion is inflated under internal pressure and whilst still in plastically deformable state to a larger tube and the inflated tube is drawn off (hauled off) mechanically (and, for example, rolled up) all by a process similar to that conventionally used in the manufacture of plastic bags, the extrusion and hauling-off tend to stretch the matrix 14 and the bodies 12, 16 in the direction of longitudinal extrusion, whilst the blowing tends also to stretch the matrix 14 and the bodies 12, 16 circumferentially in the circumferential direction of the tube. Preferential elongation of the bodies 12, 16 in one direction in the "plane" of the sheet material renders the light diffusing properties of the material asymmetric, that is to say the material diffuses light through a narrower angle in a plane perpendicular to the sheet material and parallel with direction of elongation than in a plane perpendicular to the sheet material and to the direction of elongation. By controlling the draw-off rate relative to the extrusion and inflation rates, this asymmetry can be controlled or neutralised to produce a light diffusing material having a controlled degree of, or no, diffusive asymmetry. Since, with the production method described, a screen material having no diffusive asymmetry is one in which each body 12, 16 has, in principle, been stretched equally in all directions in the plane of the sheet, it will be appreciated that in such a material the shapes of the bodies may range from oblate spheroids to circular lenticular or disc-like bodies.

Examples of manufacture of optically diffusing screens by the technique described above are described in more detail below:-

Examples

In the following examples, an extrudable thermoplastics compound was produced by mixing the component polymers in a compounding extruder fitted with a cavity transfer mixer. The compound was then extruded into a thin film using a conventional extrusion line incorporating film blowing equipment. The process temperature was 180°C. The extrusion die had a diameter of 180 mm with a (radial) die gap of 1.2 mm and the extruded material was blown to a diameter of either 400 mm or 480 mm enabling the production of two continuous films (by flattening the blown tube and slitting or trimming along opposite longitudinal edges of the flattened tube), of a width of approximately 24 inches (600 mm) or 30 inches (720 mm) respectively. The results provided for Examples 1 and 2 were taken from 30 inch width film, that is a bubble diameter of about 480 mm. In the process, the bubble is collapsed to provide two films each representing half the circumference of the bubble. The reduction in thickness of 10:1 comes from the ratio of bubble to die diameter (about 3:1) and haul-off rate. Bubble ratios in excess of 5:1 can be achieved. The intention, in the examples herein, was to produce a light-diffusing material with a high angle of view and approximately symmetric light-diffusing properties, i.e. diffusion of light substantially equally in all directions. The haul-off rate controls the symmetry or degree of asymmetry in diffusion (for a given bubble ratio) whereas the extrusion rate; that is, the rate at which the extruder pumps material controls the angle of view (mainly by controlling the product thickness). For symmetric materials the haul-off rate and the extrusion

rate should be very similar for the exemplified approx. 10:1 thickness reduction.

Example 1

This example was intended as a comparison or "control" against which the performance of a screen material embodying the invention could be fairly assessed. Extrudable plastics material was compounded, blending ethylene/ethyl acrylate copolymer resin, LE 5861 (available from Borealis/Distrupol) with polystyrene resin, N1910, (available from Victor Plastics) in the ratio 85 : 15, and the resulting material extruded through an annular die and blown as described above. The finished film thickness after extrusion and blowing was 124 μm . Samples of this film were laminated to a polarising film, Polaroid type KE and separately to a tinted acrylic sheet, the neutral density of which was 0.3 and to a similar acrylic sheet with a neutral density of 0.2. As the ethylene/ethyl acrylate copolymer resin and the polystyrene resin are incompatible (i.e. each is substantially insoluble in the other), the compounding process resulted in a quasi emulsion or dispersion of minute droplets of molten polystyrene resin in the molten acrylate copolymer resin. Because of the difference in refractive index of the two resins, the film produced was light-diffusing.

Example 2

In this example in accordance with the present invention, the compounding and extrusion process as described in Example 1 was repeated except that the compound comprised, in addition to ethylene/ethyl acrylate resin and clear polystyrene resin in the same proportions as in Example 1, 2% of pigmented polystyrene resin, type Lacqrene 163. The finished film thickness was 125 μm . (Polystyrene Lacqrene 163 black 1002 is available from Elf Atochem and contains less than 3% carbon black).

The materials produced in accordance with Examples 1 and 2 were compared in respect of angle of view, gain and contrast. The results are summarised in Table 1 as follows:

Table 1

	Angle of View	Gain	Contrast
Material of Example 1 (unlaminated)	70 x 65	1.74	-
Material with polarised layer	71 x 64	0.86	0.33
Material with tinted acrylic layer (neutral density 0.3)	65 x 57	0.94	0.3
Material with tinted acrylic layer (neutral density 0.2)	65 x 57	1.18	0.2
Material of Example 2	66 x 60	1.56	0.2

(The two figures in each entry in the Angle of View column in Table 1 denote the angle of view in two orthogonal planes, the material being in each case asymmetrically diffusing. It will be understood that the polarised layer and tinted acrylic layer referred to were laminated to the respective samples of the material of Example 1 in order to approximate to the contrast-enhancing effect of the pigmented bodies in the material of Example 2).

Although the gain measurement for the material of Example 2 is slightly reduced, as compared with the unlaminated material of Example 1, it is substantially greater than for the other material of improved contrast illustrated

in the table (and in which the improved contrast is achieved by lamination with either a tinted acrylic layer or a polariser layer).

Whilst, for the purposes of the measurements illustrated in the above table, the material of Example 2 was not laminated to any other material, it will be understood that, in any particular application, that extended, blown material may be laminated to a transparent or reflective substrate or superstrate.

The materials described may also be used with advantage in other areas where optically diffusive screens are utilised, for example, as layers to be incorporated on or in LCD displays, particularly pixelated LCD graphic displays, for example to reduce the susceptibility of the individual pixels.

Referring to Figure 2, a high-contrast light-diffusing material embodying the invention, according to another aspect, comprises, arranged on a supporting substrate 110, a light-diffusing layer comprising discrete transparent bodies 112 embedded in a matrix 114 of a lower refractive index comprising a light-filtering material preferably with neutral filtering characteristics (i.e. attenuating all wavelengths of colour substantially equally so as not to impart any colour "tinting").

In the arrangement shown, the transparent bodies 112 are in the form of spheres of substantially the same diameter as one another and the thickness of the matrix 114 corresponds substantially to the diameter of said spheres, so that the spheres lie in a mono-layer resting on the upper surface of the substrate 110 and are just exposed at the free surface of the matrix layer 114.

Where the layer 112 is transparent, a parallel beam of light directed normally onto the rear (lower) surface of the layer 110 will pass therethrough and the

portions of the beam aligned with the transparent spheres 112 will be refracted thereby, (because the matrix 114 is of a lower refractive index than the spheres 112) to exit from the layer 112, 114 over a range of different directions, i.e. to be diffused. Each sphere 112 thus acts as a tiny convex lens. It will be understood that, where each sphere extends precisely for the whole depth of the matrix layer 114 and no further, any ray of light, perpendicular to the plane of the screen, passing through such a sphere 112 other than precisely along its vertical axis, will also have to pass through a certain amount of the matrix material 114 before reaching the sphere 112 and after leaving the latter and before exiting from the diffusive layer and thus will be, to some extent, attenuated by the matrix material 114. Clearly if the matrix material 114 were entirely opaque, with the arrangement illustrated in Figure 2, substantially no light could pass through the product. However, by judicious selection of the darkness of the filter 114, it can be ensured that, for each sphere 112, the attenuation of light for light entering the layer 112, 114, normally, (i.e. perpendicularly) within a radial distance from the central axis of the sphere which is only slightly less than the radius of the sphere itself, is significantly lower than for light passing normally through the matrix material 114 without passing through any sphere 112. Accordingly, light passing through the spheres 112 and thus subjected to the "scattering" or "diffusing" effect of the spheres, is very little attenuated whilst light passing through the matrix material between adjacent spheres, is severely, preferably almost entirely, attenuated. It will be appreciated that, where the material is used as a rear projection screen, for example, light which passes through the matrix material without deviation will contribute nothing to image forming for any observer not viewing the screen along a line precisely perpendicular to the latter. More importantly, however, the dark nature of the matrix significantly reduces, in such a scenario, the amount of ambient light, (and thus light without image content), which may

be reflected towards an observer, and thus minimises the loss of visual contrast experienced by an observer in high ambient light conditions.

Conversely, Figure 3 illustrates an arrangement which corresponds substantially with that of Figure 2 except that in the arrangement of Figure 3 it is the spheres 112' which are opaque and the matrix material 114' which is transparent. In this case, the transparent matrix material 114' preferably has a refractive index higher than that of the spheres 112' so that light passing through the substrate 110 and entering the regions between adjacent opaque spheres 112' will either be totally reflected at the boundaries between the spheres 112' and the matrix 114' or will tend, at any rate, to be refracted to pass only through minor portions of the spheres 112' and re-enter the transparent region, again enhancing the proportion of the image-forming light scattered by the transparent regions as compared with light reflected from the other regions. In either case (Figure 2 or Figure 3) the effect is to enhance the screen contrast, as compared with a plain light-scattering Lambertian front or rear projection screen, thereby enhancing contrast in high ambient light conditions.

It will be appreciated that, in practice, the desired effect may be achieved, at least to a major extent, even if the heights of the bodies 112, 112' relative to the upper surface of the substrate 110 do not correspond exactly to the depth of the matrix 114, 114'. Indeed, with the arrangement described with reference to Figure 2, the contrast afforded by the material may be significantly improved if the matrix 114 is of a depth somewhat less than the heights of the bodies 112, perhaps even only half the heights of the spherical bodies 112. It will also be appreciated that the bodies 112 need not be spherical but may be of some other shape.

Furthermore, it will also be appreciated that the desired contrast enhancing effect may be achieved even if the matrix 114, 114' is of a somewhat greater depth than the bodies 112, 112' and, indeed, may be achieved where the bodies 112 are not arranged strictly in a mono-layer but in a layer of several bodies deep, as illustrated in Figure 4.

As with the embodiment of Figure 1, the structure described with reference to Figures 2 to 4 may be achieved in several ways. Thus, for example, pre-formed solid bodies 112 of transparent material may be mixed with a tinted or dyed molten thermoplastics polymer which is spread on the substrate 110 in a thin layer in a molten state and allowed to harden or solidify to form the material of Figure 2 or, alternatively, tinted or opaque spheres 112' may be mixed with a molten and transparent thermoplastics polymer which is likewise spread in a thin layer on the substrate 110 and allowed to harden or solidify, to form the material of Figure 3. Alternatively, of course, the initially fluid matrix material may be a monomer or other polymer precursor which is spread in a fluid state onto the matrix 110 and thereafter irradiated or otherwise caused to polymerise or set. In further variants of the method, mutually incompatible liquids, one being dyed or tinted, may be mixed together so that small bodies or droplets of the one are dispersed within the other to form an emulsion or quasi-emulsion which is spread onto the substrate after which the materials are allowed or caused to harden, at least the matrix material is caused or allowed to harden.

Thus, a minor proportion of a polymer containing pigment or dye may be dispersed within the bulk of a transparent polymer material incompatible with the pigmented or dyed polymer, such that the pigment or dye remains within the first-mentioned polymer and is not dispersed in the bulk of the transparent material. As a result, when the resulting product is used as a projection screen, contrast is enhanced and gain substantially unaffected.

Whilst, in the above description with reference to Figures 2 to 4, it has been assumed that the substrate 110 is transparent, it will be appreciated that the substrate 110 may be made reflective, for example, by being formed as a layer of reflective metal foil, where the material is to be used as the front projection screen. Furthermore, of course, the substrate 110 may be dispensed with altogether.

If desired, the material described with reference to Figure 1 may also be made so thin that the bodies 12, 16, have diameters of the same order as the thickness of the screen, so that the bodies 12, 16 effectively form a mono-layer.

As with the embodiment of Figure 1, the screen of any of Figures 2 to 4 may be made by a process in which a blend of incompatible thermoplastic polymers is formed into a thin film by forming a smaller diameter tube by extrusion and inflating the tube under internal pressure and whilst still in plastically deformable state to a much larger tube, by a process similar to that conventionally used in the manufacture of plastic bags.

CLAIMS

1. A high contrast projection, depixelating, or the like screen, comprising a primary matrix of a first, transparent material, a first quantity of discrete bodies of a second transparent material of a refractive index different from the primary matrix material distributed in said primary matrix and a second quantity of discrete light absorbing or filtering bodies distributed in said primary matrix.
2. A screen according to claim 1 wherein the bodies of said second quantity each comprise a matrix of a transparent material incorporating light absorbing or opaque particles.
3. A screen according to claim 1 wherein the bodies of said second quantity each comprise a transparent material incorporating a light filtering dye.
4. A screen according to claim 2 or claim 3 wherein the transparent material or matrix material of said second quantity of discrete bodies has a different refractive index than from said primary matrix.
5. A screen according to claim 4 wherein the materials of said first and second quantity have higher refractive indices than said primary matrix.
6. A high contrast projection, depixelating, or the like screen, comprising discrete bodies of a first material and refractive index in a matrix of a second material and refractive index, one said material being transparent and the other being light-filtering.

7. A screen according to claim 6 wherein said discrete bodies are light-transmitting bodies and said matrix is a light-filtering binder of lesser transparency than said bodies.
8. A screen in accordance with claim 6 or claim 7, wherein said layer has a thickness corresponding substantially with the mean diameter of said bodies.
9. A screen according to any preceding claim wherein said discrete bodies are substantially spherical.
10. A screen according to any preceding claim wherein said discrete bodies are extended substantially equally in all directions in the plane of the screen.
11. A screen according to any of claims 1 to 8 wherein said discrete bodies are extended or elongated preferentially in one direction in the plane of the screen whereby the screen has asymmetric light-diffusing properties.
12. A method of forming a screen in accordance with any of claims 1 to 5, comprising forming a mixture comprising a plurality of discrete light-transmitting bodies and a plurality of discrete light absorbing or attenuating bodies in a fluid, light-transmitting matrix or binder, forming the resulting mixture into a thin layer or sheet, and causing or allowing at least said binder to set.
13. A method of forming a screen in accordance with any of claims 1 to 5 comprising compounding, in a molten or plastic state, a first light-transmitting thermoplastics matrix material with a second light-transmitting thermoplastics material insoluble in, and having a different refractive index from the first, and with a third thermoplastics material insoluble in the first, said third material

being light-absorbing or attenuating, the method further comprising extruding the resulting compound through a slot.

14. A method of forming a screen in accordance with any of claims 6 to 8 comprising compounding, in a molten or plastic state, two mutually insoluble thermoplastics materials one of which is a tinted, light-filtering material and extruding the resulting compound through a slot.

15. A method according to claim 13 or claim 14 wherein the material is extruded through an annular slot to form a tube which is blown, whilst the material is still at a temperature at which it is plastically deformable, to form a thin tubular film.

16. A method according to claim 15 wherein the tubular film is subsequently slit to form a thin sheet.

17. A method according to any of claims 1 to 5 comprising forming a mixture of a first, liquid settable, light-transmitting synthetic resin material, a second light-transmitting material insoluble in the first material and having a different refractive index from the first material, and a third light-transmitting material insoluble in the first material and being light-absorbing or attenuating, said second and third materials being in the form of discrete, finely dispersed bodies, the method including casting the mixture onto a support or mould and covering or allowing said first material to set in a thin layer or sheet.

18. A method according to claim 17 wherein one or both of said second and third materials is a liquid, at least during said mixing.

19. A projection, depixelating or the like screen, substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

20. A method of forming a projection, depixelating or the like screen, substantially as hereinbefore described with reference to the accompanying drawing.

1/1

Fig.1.

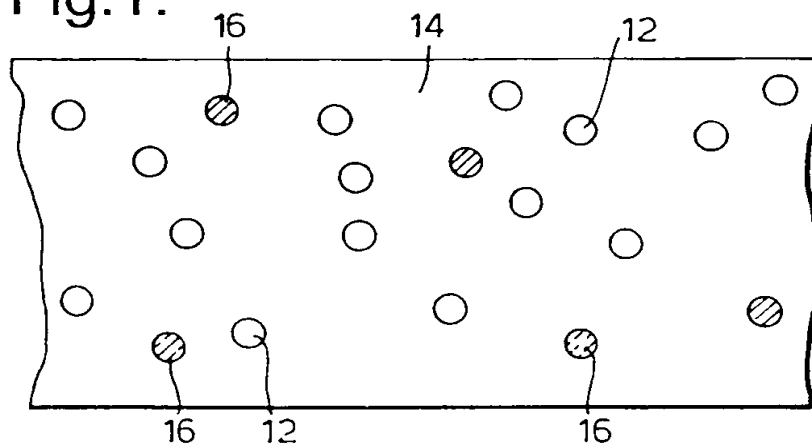


Fig.2.

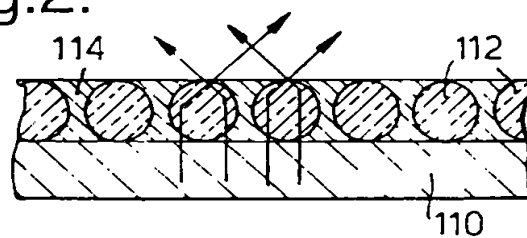


Fig.3.

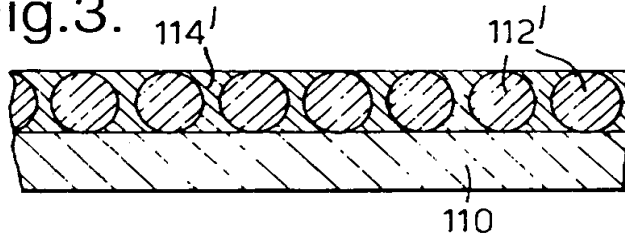
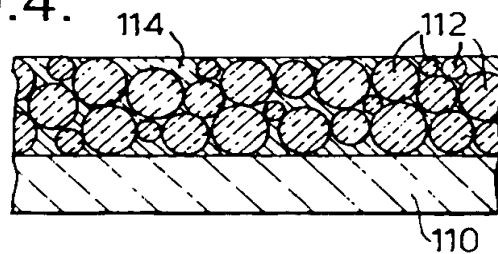


Fig.4.



INTERNATIONAL SEARCH REPORT

Int. Application No.

PCT/GB 00/01773

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B5/02 G03B21/62

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G02B G03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 655 262 A (DEPALMA JAMES J) 11 April 1972 (1972-04-11) column 3, line 39 - line 50; figure 3; examples 3-10 ---	1-3, 6, 7, 9, 10, 12-20
X	US 5 563 738 A (VANCE DENNIS W) 8 October 1996 (1996-10-08) column 5, line 38 - column 9, line 67; figures 5-10 ---	1-20
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☒ Further documents are listed in the continuation of box C.

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
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INTERNATIONAL SEARCH REPORT

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PCT/GB 00/01773

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 401 700 A (TRANS-LUX DAYLIGHT PICTURE SCREEN CORPORATION) 14 November 1933 (1933-11-14) page 1, line 57 -page 3, line 48; claims 1,4 ---	1-3,6,7, 9,10, 12-20
X	US 1 389 357 A (HOCHSTETTER F W) 30 August 1921 (1921-08-30) page 1, line 13 -page 2, line 18; claims 1,2; figures 1-3 ---	1-20
A	EP 0 843 203 A (NASHUA PHOTO LIMITED ;NASHUA CORP (US)) 20 May 1998 (1998-05-20) cited in the application page 5, line 4 -page 6, line 46; figures 1-4 ---	1-20
A	US 4 983 016 A (YAMAMOTO YOSHIHARU) 8 January 1991 (1991-01-08) cited in the application column 3, line 35 -column 5, line 4; figures 1-5 -----	1-20

INTERNATIONAL SEARCH REPORT

information on patent family members

Int. Application No

PCT/GB 00/01773

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(71) 出願人 000165088

恵和商工株式会社

大阪府大阪市東淀川区上新庄1丁目2番5号

(72) 発明者 加藤 公子

千葉県浦安市北栄1-1-11-403

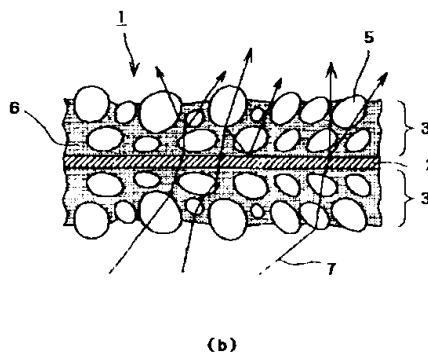
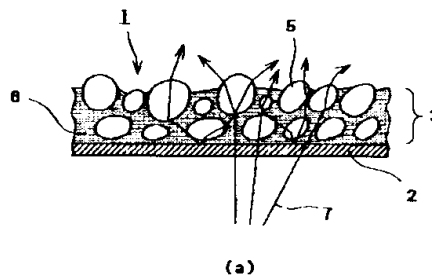
(74) 代理人 弁理士 角田 嘉宏

(54) 【発明の名称】 スクリーン用シート材

(57) 【要約】

【目的】 投影画面をシート面全体に鮮明に映し出すことができるスクリーン用シート材を提供する。

【構成】 光透過性を有する物質から構成された基材シート2と、シート2の一方もしくは両方の面に塗設された、バインダー（透明プラスチック樹脂）6、透明ビーズ5および/または着色ビーズ4からなるビーズ層3から構成されたスクリーン用シート材1。



【特許請求の範囲】

【請求項1】 光透過性の基材シートと、前記基材シートの少なくとも一方の面に塗設されたビーズ層から構成された、透過型スクリーンに用いられるスクリーン用シート材であって、

前記基材シートが、光透過性を有する物質から構成され、および前記ビーズ層が、透明プラスチック樹脂、透明ビーズおよび、または着色ビーズから構成されていることを特徴とするスクリーン用シート材。

【請求項2】 前記ビーズ層が、前記基材シートの両面に塗設されている請求項1に記載のスクリーン用シート材。

【請求項3】 前記光透過性を有する物質が、ポリエチレンテレフタレートである請求項1もしくは2に記載のスクリーン用シート材。

【請求項4】 前記透明ビーズおよび、または着色ビーズが、様々な粒度のビーズから構成されている請求項1ないし3のいずれかに記載のスクリーン用シート材。

【請求項5】 前記透明ビーズおよび、または着色ビーズが、前記バインダーに埋設されたビーズと、前記バインダーに部分的に埋設されたビーズから構成されている請求項1ないし4のいずれかに記載のスクリーン用シート材。

【請求項6】 前記ビーズ層が、10~99%の全光線透過率および2~95%のヘイズを有する請求項1ないし5のいずれかに記載のスクリーン用シート材。

【請求項7】 前記ビーズ層が、難燃剤をさらに含む請求項1ないし6のいずれかに記載のスクリーン用シート材。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、スクリーン用シート材、特に、投影画面を鮮明に映し出すことができる透過型スクリーン用シート材に関する。

【0002】

【従来の技術および発明が解決しようとする課題】従来より、プラスチックフィルム、布、ガラス繊維などから構成されたシート基材に、ガラスビーズ等を塗布してなるスクリーン用シート材が汎用されていた。しかしながら、これら従来のスクリーン用シート材によると、投影された画像が、スクリーン全体にわたって鮮明に映し出すことが難しく、また、スクリーンの周縁部が薄暗くなり、視聴者（鑑賞者）に不快感を与えるものであった。

【0003】また、従来のスクリーン用シート材では、シート材の投影面側にのみ、映像が映し出されるに過ぎず、したがって、シート材裏面は何ら利用されていなかったのが実情であった。

【0004】

【課題を解決するための手段】本発明は、上述した従来

のスクリーン用シート材において指摘されていた問題点に鑑みて、スクリーン面全体に鮮明な映像が得られるようなスクリーン用シート材を提供する目的で発明されたものであり、その要旨とするところは、透過性を有する物質から構成された基材シートと、該基材シートの少なくとも一方の面に塗設されたビーズ層から構成されたスクリーン用シート材である。

【0005】すなわち、本発明のビーズ層の構成には、以下の三態様が含まれる。

【0006】① 透明ビーズとバインダーからなるビーズ層（図1(a)）。

【0007】② 着色ビーズとバインダーからなるビーズ層（図1(b)）。

【0008】③ 透明ビーズ、着色ビーズおよびバインダーからなるビーズ層（図1(c)）。

【0009】そして、本発明における基材シートとしては、プラスチックフィルム、ガラス、ガラス繊維、セラミック繊維、布、合成紙等、光透過性のものが使用され、シート厚みは特に限定されるものではないが、加工の難易性およびハンドリング性を考慮して、10~1000 μ m程度が好ましい。

【0010】また、透明ビーズとしては、アクリル樹脂ビーズ、ガラスビーズ等が使用でき、透明ビーズの粒径は、特に限定されるものではないが、光拡散効果などを考慮すれば、1~100 μ m程度のものを、好ましくは、粒度の異なるビーズを混在させて用いる。同様に、着色ビーズとしては、プラスチック（例えば、アクリルコポリマー）やガラス等をその主成分とするものであれば良く、また、これらビーズを着色するための着色材としては、顔料、例えば、乳白色を付与する酸化チタン、青色を付与するフタロシアニンブルー、緑色を付与するシアングリーン、茶色を付与する赤色酸化鉄などが使用でき、この内、鮮明度の高い画像が得られることから、酸化チタンが特に好ましい。なお、着色ビーズの粒径は、特に限定されるものではないが、映像効果などを考慮して、1~100 μ m程度が好ましい。なお、透明ビーズと着色ビーズを混合して使用する場合（図1(c)）、両者の混合比は、画像鮮明度を考慮すれば、99:1重量%~1:4重量%の範囲が好ましい。

【0011】さらに、バインダーとしては、透明プラスチック樹脂（例えば、アクリル樹脂あるいはウレタン樹脂）が、本発明において使用できる。なお、ビーズとバインダーとの配合比は、光拡散効果などを考慮して、バインダー100重量部に対して、ビーズ5~90重量部の範囲が好ましい。

【0012】さらに、本発明のビーズ層の厚みは特に限定されるものではないが、周知のロールコート方式による基材シートへの塗設の難易性、強度および光拡散効果などを考慮して、10~500 μ m程度が好ましい。さらに、ビーズ層内におけるビーズの配置態様としては、光

拡散効果などを考慮すれば、バインダーに埋設されたビーズとバインダーに部分的に埋設されたビーズを混在させて用いること、ならびに、ビーズを基材シート表面に分散あるいは基材シート表面をほぼ被うように分布させる態様が好ましい。

【0013】なお、本願発明のビーズの塗工態様としては、図2(a)に示した基材シートの一方の面にのみビーズ層を形成する(片面塗工の)態様と、さらに良好な光透過性・光拡散効果を得るために、図2(b)に示した基材シートの両面にビーズ層を形成する(両面塗工の)態様がある。

【0014】さらに、本発明のシート材を構成する、ビーズ、基材シート、あるいはバインダーに、防災機能を付加する目的で、難燃処理、すなわち難燃剤、例えば、トリフェニルホスフェート、ポリクレジルホスフェート、などを配合することができる。

【0015】そして、本発明により得られたスクリーン用シート材の使用態様としては、周知の態様、例えば、ローラースクリーン(図3(a))あるいはパネルスタンド型スクリーン(図3(b))などのスクリーン形態に適用で

きる。

【0016】**【実施例】**以下、本発明のスクリーン用シート材の実施例につき説明する。

【0017】本発明の構成によると、図2(a)に示したように、投影機から放たれた光線7は、スクリーン用シート材1の光透過性の基材シート2を透過して、ビーズ*

*層3のバインダー6中に分散された着色ビーズ4および/または透明ビーズ5との接触・屈折・反射を幾度となく繰り返した末に、ビーズ層3を通過して、均質に拡散した光をもたらすのである。

【0018】また、図2(b)に示したような、ビーズ層3、3を両面塗工することで、さらに、光線7の屈折・反射パターンが多様となり、二つのビーズ層3、3を通過した光の拡散性および均質性は、さらに高められる。

【0019】これにより、ビーズ層3を通過した光の拡散性は均質となり、また、スクリーン用シート材1は投影機から放たれた光線7の一部を反射し、一部を透過するので、スクリーンに明るく鮮明な映像を映し出すのである。

【0020】また、図1(c)に示したように、着色ビーズ4と透明ビーズ5を併用することにより、光の拡散の程度を加減することができ、さらに、使用する着色ビーズ4と透明ビーズ5の混合比ならびに粒径を調整することで、スクリーン輝度の加減も可能となるのである。

【0021】**実施例1**

200 μ mの厚さのポリエチレンテレフタレートシート(「PET 200」;ダイヤホイル株式会社製)を基材シートとして用い、その上面に、周知のロールコート方式で、下記表1に示した組成の塗工液を塗設し、厚さ50 μ mのビーズ層を形成し、図1(a)に示した構造を有する本発明のスクリーン用シート材を調製した。

【0022】

【表1】

アクリル樹脂	100重量部
透明アクリルビーズ(粒径:30 μ m)	40重量部
イソシアナート(硬化剤)	5重量部

【0023】このシート材を、全光線透過率ならびにヘイズの各特性に関して、それぞれJIS K 7105のA法およびJIS K 7105の方法に準拠して試験を行った。その試験結果を下記表2に示した。

【0024】

【表2】

全光線透過率	94%
ヘイズ	80%

※スクリーンの映像面として用いたところ、スクリーン面全体に極めて明るい迫力のある映像が映し出された。

【0026】**実施例2**

実施例1と同じポリエチレンテレフタレートシートを基材シートとして用い、その上面に、周知のロールコート方式で、下記表3に示した組成の塗工液を塗設し、厚さ50 μ mのビーズ層を形成し、図1(b)に示した構造を有する本発明のスクリーン用シート材を調製した。

【0027】

【表3】

【0025】そして、本実施例で得られたシート材を、※

アクリル樹脂	100重量部
二酸化チタン含有アクリルビーズ(粒径:20 μ m)	30重量部
イソシアナート(硬化剤)	5重量部

【0028】このシート材を、実施例1と同様の方法にて、全光線透過率およびヘイズの各特性に関して試験を行った。その試験結果を下記表4に示した。

★【0029】

【表4】

★50

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全光線透過率	80%
ヘイズ	87%

【0030】そして、本実施例で得られたシート材を、スクリーンの映像面として用いたところ、実施例1のスクリーン材と同様、スクリーン面全体に極めて明るい迫力のある映像が映し出された。

* 【0031】実施例3

実施例1と同じポリエチレンテレフタレートシートを基材シートとして用い、その上面に、周知のロールコート方式で、下記表5に示した組成の塗工液を塗設し、厚さ60 μ mのビーズ層を形成し、図1(c)に示した構造を有する本発明のスクリーン用シート材を調製した。

【0032】

* 【表5】

アクリル樹脂	100重量部
透明アクリルビーズ（粒径：30 μ m）	30重量部
二酸化チタン含有アクリルビーズ（粒径：20 μ m）	10重量部
イソシアナート（硬化剤）	5重量部

【0033】このシート材を、実施例1と同様の方法にて、全光線透過率およびヘイズの各特性に関して試験を行った。その試験結果を下記表6に示した。

【0034】

【表6】

全光線透過率	89%
ヘイズ	84%

※スクリーンの映像面として用いたところ、実施例1のスクリーン材と同様、極めて鮮明な映像が映し出された。

【0036】実施例4

実施例1で用いたのと同じポリエチレンテレフタレートを基材シートとして用い、その上面に、周知のロールコート方式で、下記表7に示した組成の塗工液を塗設し、厚さ約50 μ mのビーズ層を形成した。

【0037】

【表7】

【0035】そして、本実施例で得られたシート材を、※

アクリル樹脂	100重量部
透明アクリルビーズ（粒径：20 μ m）	35重量部
イソシアナート（硬化剤）	5重量部

【0038】次に、基材シートの下面（前記上面の裏面）に、周知のロールコート方式で、前記表7に記載の組成を有する塗工液を塗設し、厚さ約50 μ mのビーズ層を形成し、図2(b)に示した構造を有する本発明のスクリーン用シート材を調製した。

【0039】このようにて得られたシート材を、実施例1と同様の方法にて、全光線透過率およびヘイズの各特性に関して試験を行った。その結果を、下記表8に示した。

【0040】

【表8】

全光線透過率	86%
ヘイズ	84%

★【0041】そして、本実施例にて得られたシート材を、スクリーンの映像用（映写用スクリーン材）として用いたところ、実施例1のスクリーン材と同様、極めて鮮明な映像が映し出された。

【0042】実施例5

実施例1で用いたのと同じポリエチレンテレフタレートを基材シートとして用い、その上面に、周知のロールコート方式で、下記表9に示した組成の塗工液を塗設し、厚さ約30 μ mのビーズ層を形成し、難燃剤を利用した態様の本発明のスクリーン用シート材を調製した。

【0043】

【表9】

★

アクリル樹脂	100重量部
透明アクリルビーズ（粒径：10 μ m）	40重量部
イソシアナート（硬化剤）	5重量部
トリフェニルホスフェート（難燃剤）	5重量部

【0044】このシート材に関して、基材シートを水平に保ち、ガスバーナーの炎を2cmの距離を開けて、シート端部および中央部に設定し、5～10秒間燃焼を継続し

☆、シートの燃焼状態を目視で観察し、評価した。その結果、10秒間の燃焼でも、シートは着火し、やや黒ずむものの、延焼することなく自然消火し、本実施例のシ

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ート材の難燃性が良好であることが確認できた。また、このシート材を実施例1と同様の方法にて、全光線透過率およびヘイズの各特性に関して試験を行い、その結果を下記表10に示した。

【0045】

【表10】

全光線透過率	94%
ヘイズ	80%

【0046】さらに、このシート材を、スクリーン材の映像用（映写用スクリーン材）として用いたところ、実施例1のスクリーン材と同様、極めて鮮明な映像が映し出された。

【0047】上記実施例の結果から、本発明のスクリーン用シート材を構成するビーズ層の全光線透過率およびヘイズの各特性値を、それぞれ10～99%および2～95%の範囲内に調整することが、所望の映像効果を得るための指標の一つになることを知見するに至ったのである。

【0048】

【発明の効果】本発明のスクリーン用シート材による

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と、シート材に導入された光線の拡散性が改善されて均質に拡散された光線がスクリーン全面に極めて良好な映像を提供でき、鑑賞者に対して、映像的・美観的に好ましい印象を付与できる。

【図面の簡単な説明】

【図1】(a)、(b) および(c) は、本発明の実施例を示す一部断面図である。

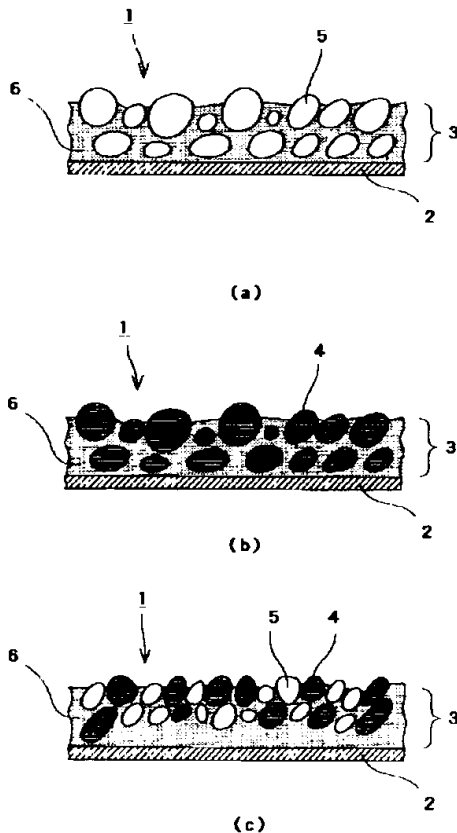
【図2】(a) および(b) は、本発明の構成を説明する図である。

【図3】(a) および(b) は、本発明の使用態様を示す図である。

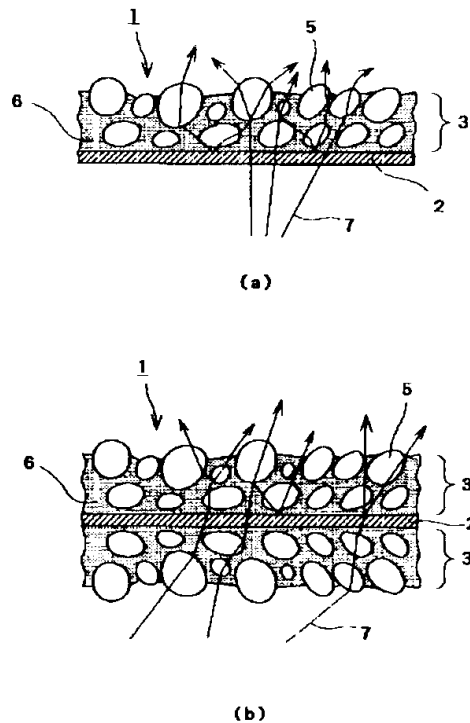
【符号の説明】

- 1…スクリーン用シート材
- 2…基材シート
- 3…ビーズ層
- 4…着色ビーズ
- 5…透明ビーズ
- 6…バインダー
- 7…光線

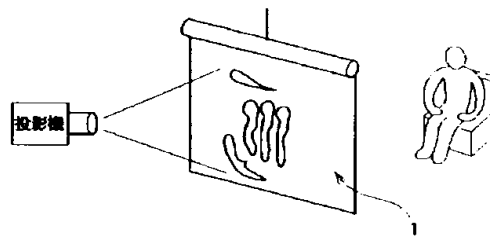
【図1】



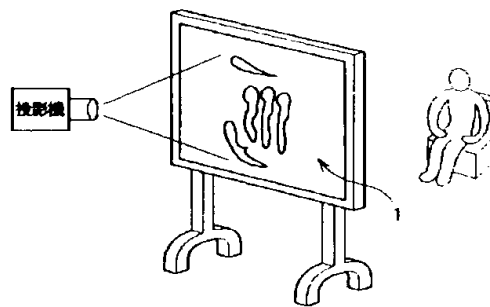
【図2】



【図3】



(a)



(b)

RECD 02 JUL 2001

WIPO

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference I12848WO-H/JC	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/01773	International filing date (day/month/year) 10/05/2000	Priority date (day/month/year) 11/05/1999
International Patent Classification (IPC) or national classification and IPC G02B5/02		
Applicant MICROSHARP CORPORATION LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 9 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 18/10/2000	Date of completion of this report 28.06.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer THEOPISTOU, P Telephone No. +49 89 2399 2471 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/01773

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-13 as originally filed

Claims, No.:

1-20 as originally filed

Drawings, sheets:

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/01773

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 19, 20.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 19, 20 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)

Yes: Claims

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/01773

	No:	Claims	1,6-11,12,17,18
Inventive step (IS)	Yes:	Claims	
	No:	Claims	2-5,13-16
Industrial applicability (IA)	Yes:	Claims	1-18
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

Claims 19 and 20 are not in conformity with Rule 6.2 (a) PCT because they rely in respect of the technical features of the invention on reference to drawings.

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Novelty and Inventive step

Reference is made to the following documents:

- D1 : US-A-3 679 451 (MARKS A M ET AL) 25 July 1972 (1972-07-25)
- D2 : US-A-3 751 135 (CLAUSEN E ET AL) 7 August 1973 (1973-08-07)
- D3 : GB 401 700 A (TRANS-LUX DAYLIGHT PICTURE SCREEN CORPORATION) 14 November 1933 (1933-11-14)
- D4 : US-A-2 378 252 (STAEHLE H C ET AL) 12 June 1945 (1945-06-12)
- D5 : PATENT ABSTRACTS OF JAPAN JP 07 005570 A (KEIWA SHOKO KK) (English Abstract) 10 January 1995 (1995-01-10)
- D6 : PATENT ABSTRACTS OF JAPAN JP 07 077681 A (TOPPAN PRINTING CO LTD) (English Abstract) 20 March 1995 (1995-03-20)
- D7 : US-A-5 563 738 (VANCE DENNIS W) 8 October 1996 (1996-10-08)
- D8 : EP-A-0 843 203 (NASHUA PHOTO LIMITED ;NASHUA CORP (US)) 20 May 1998 (1998-05-20) cited in the application

Documents D1, D4, D5 and D6 were not cited in the international search report.

- 1.a) The present application does not satisfy the criterion set forth in Article 33(2) PCT because the subject matter of **claim 1** is not novel. Document D1, which is regarded as being the closest prior art, discloses (the references in parentheses applying to this document):
A high contrast projection screen, comprising (cf. Fig. 3 and col. 3, ln. 30-col. 5, ln. 14)
a primary matrix of a first, transparent material (non-glare transparent polymeric coating (5)),

a first quantity of discrete bodies (particles (8) or (9)) of a second transparent material of a refractive index different from the primary matrix material distributed in said primary matrix (cf. col. 4, ln. 7-12 and ln. 61-73) and
a second quantity of discrete light absorbing or filtering bodies (10) distributed in said primary matrix (cf. col. 4, ln. 12-17 and ln. 54-59).
Therefore in view of D1 the subject matter of **claim 1** is not novel.

- 1.b) It is noted that the subject matter of **claim 1** is well known in the prior art, see for example:
- a) D2: (cf. Fig. 2 and col. 1, ln.54-col. 2, ln. 61), where a rear projecting screen comprises an opaline or milky plastic sheet of transparent resin wherein calcium and/or magnesium carbonate grains and light refracting glass particles of higher refractive index than the transparent resin are dispersed,
 - b) D3 (cf. pg. 1, ln. 57-pg. 2, ln. 46), where a screen is formed from cellulose-acetate material having incorporated therein a light diffusing agent and a light-filtering agent,
 - c) D4 (cf. Fig. 4 and pg. 2, left col., ln.5-right col., ln. 11), where a screen (10') comprises a light absorbing layer (16) of thermoplastic material or gelatin containing a light absorbing substance, such as dyes, or dopes and lacquers containing dark pigments or dark coloured varnishes, and transparent light refracting spherules (17), or
 - d) English abstract of D5, where transparent beads (5) and/or coloured beads (4) are dispersed in a transparent plastic resin (binder (3)) forming a sheet material for a screen.

Each one of these documents renders the subject-matter of **claim 1** not novel.

- 2) Dependent **claims 2-5** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:
- claims 2 and 3** are obvious in view of English abstract of D6, where liquid crystal droplets (10) containing a light filtering dyestuff (8) are dispersed into a polymeric medium,
 - claim 4** concerns a choice of material parameters which the skilled person would select, in accordance with circumstances, without the exercise of inventive skill. See e.g. D4 (cf. pg. 2, left col., ln. 50-59), where the material for the light refracting bodies or spherules (17) can be selected to have refractive index

between 1.45-1.75,

-**claim 5** concerns an obvious choice of material parameters, see e.g. D2, where the refracting particles are selected to have a refractive index 5-15 % higher than the index of refraction of the material into which they are dispersed.

- 3) The present application does not satisfy the criterion set forth in Article 33(2) PCT because the subject matter of **claim 6** is not novel. Document D1 (cf. Fig. 3 and col. 3, ln. 52-72) discloses a high contrast projection screen comprising discrete bodies ((8) or (9)) of a first material and refractive index in a matrix (5) of a second material and refractive index, one said material being transparent and the other light-filtering (cf. col. 4, ln. 60-73). See also point (1.b) above, where other documents ((a)-(d)) are mentioned containing all technical features of claim 6. Each one of these documents renders the subject-matter of **claim 6** not novel.
- 4) Dependent **claims 7-11** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty the reasons being as follows:
 - claim 7** is disclosed in D1 where the non-glare coating (5) is provided with absorbing materials (10) and the particles ((8), (9)) are transparent (cf. col. 4, ln. 54-73). In general the concept of light-transmitting discrete bodies dispersed in a matrix of a light-filtering binder of lesser transparency than said bodies is known in the prior art, see e.g. D2 (cf. Fig. 2 and col. 1, ln. 54-col. 2, ln. 20), where transparent, light-refracting particles are dispersed in an opaline or milky plastic sheet, or D4 (cf. Fig. 3, 4 and pg. 2, left col., ln. 5-63), where a screen (10) comprises a light absorbing layer (16) through which transparent light refracting spherules (17) extend.
 - claim 8** is known from D4 (cf. Fig. 4) where the screen (10') has the size of the spherules (17).
 - claims 9-11** are known from D4 or D1, where the discrete bodies have different shapes or different alignments i.e. spherical as in D4 (cf. Fig. 2 and 3) or plate or rod shape aligned as in D1 (cf. Fig. 1 and col. 4, ln. 67,68 and col. 5, ln. 29-32). See also D7 (cf. claims 8-10) for beads of different shapes used in a light filter.
- 5) The present application does not satisfy the criterion set forth in Article 33(2) PCT because the subject matter of **claim 12** is not novel. D1 (cf. col. 5 ln. 15-28 and claim 32), discloses a screen of similar composition in the form of a non-glare

sheet, where a mixture of the composition of the non-glare sheet is formed into a fluid coating layer which is then allowed to dry.

- 6) The present application does not satisfy the criterion set forth in Article 33(3) PCT because the subject matter of **claim 13 and 14** does not involve an inventive step. The screen is known from D1. Claims 13 and 14 differ from D1 in that the method of manufacturing is by extrusion of a compound comprising different thermoplastics instead of allowing the compound to dry as in D1. The problem to be solved by the present invention may therefore be regarded as how to provide an alternative method to manufacture a light diffusing screen. D8 (cf. pg. 5, ln. 58-pg. 6, ln. 20) discloses the manufacturing of a light diffusing screen by extruding a compound through a slot, said compound comprising a mixture of the components of the screen. The person skilled in the art would therefore consider to use such a method in order to produce the screen of claims 1-5 or 6-8.
- 7) Dependent **claims 15 and 16** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step the reason being that they are obvious in view of the manufacturing method as described in D8 (cf. pg. 6 ln.16-20).
- 8) The present application does not satisfy the criterion set forth in Article 33(2) PCT because the subject matter of **claims 17 and 18** is not novel. D3 (cf. pg. 2, ln. 46-107) discloses a screen made of similar materials, where the materials are mixed in a semi-fluid or viscous condition, then spread over a suitably dimensioned plate (support or mould) and allowed to set.

Industrial Applicability

Industrial applicability is given in the field of image projection screens (Article 33(4) PCT).

Re Item VII

Certain defects in the international application

- 1) The claims are not drafted in the two-part form contrary to the requirements of Rule 6.3(b) PCT.
- 2) The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

The following deficiencies are observed which lead to lack of clarity contrary to the requirements of Article 6 PCT:

- 1) The term "or the like" used in claims 1 and 6 is vague and unclear leaving the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear.
- 2) According to the requirements of Rule 10.2 PCT, the terminology shall be consistent throughout the application. This requirement is not met in view of the use of the expressions "light absorbing or filtering bodies" in claim 1 and "light absorbing or attenuating" in claims 12, 13 and 17 for the same feature.
- 3) The term "...allowing at least said binder to set" in claim 12 is not clear as to whether it means that either said matrix or said binder is allowed to set, or at least the binder from all the other components (i.e. discrete bodies) of the mixture is allowed to set.
- 4) The following terms should be added in the corresponding claims in order to improve their clarity:
 - claim 5 : "...first and second quantity of discrete bodies have..."
 - claim 14 : "...one of which is tinted, light-filtering material and the other transparent and extruding..."
- 5) The term "said layer" in claim 8 has not been prior defined. Presumably it implies the screen forming a layer.

* * * * *

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference I12848WO-H	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 01773	International filing date (day/month/year) 10/05/2000	(Earliest) Priority Date (day/month/year) 11/05/1999
Applicant MICROSHARP CORPORATION LIMITED		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

1, 4



None of the figures.

PROCB 00/01773

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT	
Category °	Citation of document, with indication, where appropriate, of the relevant passages

Relevant to claim No.

US 3 655 262 A (DEPALMA JAMES J)
11 April 1972 (1972-04-11)
column 3, line 39 - line 50; figure 3;
examples 3-10

1-3, 6, 7,
9, 10,
12-20

US 5 563 738 A (VANCE DENNIS W)
8 October 1996 (1996-10-08)
column 5, line 38 -column 9, line 67;
figures 5-10

1-20

US 3 751 135 A (CLAUSEN E ET AL)
7 August 1973 (1973-08-07)
column 1, line 54 -column 2, line 68;
claim 1; figures 1-3

1-20

-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

P document published prior to the international filing date but later than the priority date claimed

& document member of the same patent family

Date of the actual completion of the international search

8 August 2000

Date of mailing of the international search report

17/08/2000

Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

THEOPISTOU, P

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/01773

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 401 700 A (TRANS-LUX DAYLIGHT PICTURE SCREEN CORPORATION) 14 November 1933 (1933-11-14) page 1, line 57 -page 3, line 48; claims 1,4 ----	1-3,6,7, 9,10, 12-20
X	US 1 389 357 A (HOCHSTETTER F W) 30 August 1921 (1921-08-30) page 1, line 13 -page 2, line 18; claims 1,2; figures 1-3 ----	1-20
A	EP 0 843 203 A (NASHUA PHOTO LIMITED ;NASHUA CORP (US)) 20 May 1998 (1998-05-20) cited in the application page 5, line 4 -page 6, line 46; figures 1-4 ----	1-20
A	US 4 983 016 A (YAMAMOTO YOSHIHARU) 8 January 1991 (1991-01-08) cited in the application column 3, line 35 -column 5, line 4; figures 1-5 -----	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/01773

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 3655262	A	11-04-1972	GB 1369684 A HK 10676 A US RE28634 E	09-10-1974 05-03-1976 02-12-1975
US 5563738	A	08-10-1996	AU 7682994 A DE 69421189 D DE 69421189 T EP 0716754 A JP 9504882 T WO 9506888 A US 5781344 A	22-03-1995 18-11-1999 03-02-2000 19-06-1996 13-05-1997 09-03-1995 14-07-1998
US 3751135	A	07-08-1973	NONE	
GB 401700	A		NONE	
US 1389357	A	30-08-1921	NONE	
EP 0843203	A	20-05-1998	JP 10274704 A US 5932342 A	13-10-1998 03-08-1999
US 4983016	A	08-01-1991	JP 2199444 A DE 69009783 D DE 69009783 T DK 381417 T EP 0381417 A KR 9302611 B	07-08-1990 21-07-1994 19-01-1995 04-07-1994 08-08-1990 03-04-1993